

Waves, Sound, and Light Review

Honors Physics

1. Vibrations and Waves:

a. Properties of Waves:

i. Wave motion

ii. Wave types:

1. Transverse waves

2. Longitudinal waves

3. Equation for speed of a wave

4. Variables: Velocity (v , units: Meters per second $[m/s]$), frequency (f , units: Hertz $[Hz]$), wavelength (λ , units: Meters $[m]$)

iii. Wave interactions:

1. Interference:

a. Constructive

b. Destructive

2. Reflection:

a. Free boundary

b. Fixed boundary

3. Standing waves:

a. Definition

b. Nodes and antinodes

2. Sound:

a. Sound Waves:

i. Production of sound waves

ii. Characteristics of sound waves:

1. Frequency determines pitch

2. Speed depends on medium

iii. Doppler Effect

b. Sound Intensity and Resonance:

i. Sound intensity:

1. Definition

2. Equation for intensity of a spherical wave

3. Variables: Intensity (I , units: Watts per meter squared $[W/m^2]$), power (P , units: Watts $[W]$), distance from the source (r , units: Meters $[m]$)

4. Human hearing

5. Decibels and sound intensity

ii. Forced vibrations and resonance:

1. Definition of forced vibrations

2. Definition of resonance

c. Harmonics:

i. Standing waves on a vibrating string:

1. Definition of fundamental frequency

2. Harmonic series

3. Equation for harmonic series of standing waves on vibrating string

4. Variables: Frequency (f_n , units: Hertz [Hz]), harmonic number (n , units: None), speed of waves on string (v , units: Meters per second [m/s]), length of vibrating string (L , units: Meters [m])
- ii. Standing waves in air columns:
 1. Open/open pipe:
 - a. Definition
 - b. Equation for harmonic series of a pipe that is open at both ends
 - c. Variables: Frequency (f_n , units: Hertz [Hz]), harmonic number (n , units: None), speed of waves on string (v , units: Meters per second [m/s]), length of vibrating string (L , units: Meters [m])
 - d. All harmonics exist
 2. Open/closed pipe:
 - a. Definition
 - b. Equation for harmonic series of a pipe that is open at one end and closed on the other
 - c. Variables: Frequency (f_n , units: Hertz [Hz]), harmonic number (n , units: None), speed of waves on string (v , units: Meters per second [m/s]), length of vibrating string (L , units: Meters [m])
 - d. Only odd harmonics exist because of the placement of nodes and antinodes
3. Light and Reflection:
 - a. Characteristics of Light:
 - i. Definition of light
 - ii. Electromagnetic spectrum
 - iii. Either a particle (photon) or wave (mutually perpendicular oscillating electric and magnetic fields)
 - iv. All waves move at the same speed in a vacuum: 3×10^8 m/s
 - v. Light waves can be approximated as rays
 - b. Reflection and Flat Mirrors:
 - i. Reflection:
 1. Definition
 2. Types of reflection:
 - a. Spectral
 - b. Diffuse
 3. Relationship between angles of incidence and reflection
 - ii. Flat mirrors:
 1. Use rays to trace where image will appear
 2. Height of object equal to the height of the image
 - c. Curved Mirrors:
 - i. Concave spherical mirrors:
 1. Ray diagrams: six cases to draw
 2. Equation for mirrors
 3. Variables: Object distance (d_o , units: Centimeters [cm]), image distance (d_i , units: Centimeters [cm]), focal length (f , units: Centimeters [cm])
 4. Equation for magnification

5. Variables: Magnification (M , units: None), object distance, image distance, object height (h_o , units: Centimeters [cm]), image height (h_i , units: Centimeters [cm])
 6. Rules for drawing rays
- ii. Convex spherical mirrors:
 1. Ray diagrams: one case to draw
 2. Same equations as concave mirrors
 3. Same rules for drawing rays as concave mirrors
- d. Polarization:
 - i. Definition
 - ii. Created through a filter or light reflecting off a smooth surface
 - iii. Using a second filter at 90° eliminates polarized light
 - e. Refraction:
 - i. Definition
 - ii. Index of refraction
 - iii. Equation to determine the angle of refracted light: Snell's law
 - iv. Variables: index of refraction (n , units: None), angle (θ , units: Degrees [$^\circ$])